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(54) Title: APPARATUS AND CHEMICAL COMPOSITION FOR MAINTAINING ATMOSPHERIC HUMIDITY

(57) Abstract

Aqueous compositions formed from combining water, and at least one solute such as sodium bicarbonate, acetylsalicylic acid or mixtures thereof, and methods of using the compositions to introduce and maintain humidity in the atmosphere. The aqueous compositions can be used to prolong the shelf life of foods, including vegetables, fruits, meats, fish, seafood, cheeses, other diary products, cookies, breads, cakes, brown sugar, and tortillas, and cut flowers. The aqueous compositions can be applied directly to the food or can be applied to evaporation devices. The evaporation devices have a shell with holes formed therethrough and an absorbent material encased in the shell. When the aqueous composition has been applied to the evaporation device, the device is placed in a space that contains the food to be preserved. The evaporation device can be recharged by reapplying the aqueous composition as needed.

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APPARATUS AND CHEMICAL COMPOSITION FOR MAINTAINING ATMOSPHERIC HUMIDITY

BACKGROUND OF THE INVENTION

1. Related Application

This application is a continuation-in-part of U.S. Patent Application Serial No. 09/405,428, entitled "Evaporating Liquid into an Atmosphere," and filed September 23, 1999, which claims the benefit of U.S. Provisional Patent Application Serial No. 60/103,705, entitled "Apparatus and Methods for Evaporating Liquid into an Atmosphere," and filed October 9, 1998. Both of the foregoing applications are incorporated herein by reference.

2. The Field of the Invention

The present invention relates to chemical compositions and associated apparatus and methods for evaporating water or another liquid into an atmosphere. More specifically, the present invention relates to aqueous compositions formed from mixing water, and at least one substance that dissolves in water, such as sodium bicarbonate, a weak acid such as acetylsalicylic acid, or a mixture thereof, which facilitate, enhance, or prolong evaporation of water into the ambient atmosphere.

3. The Prior State of the Art

Over the years, many systems and devices for introducing water vapor into the air or for elevating and maintaining the humidity level in the air have been developed. Electrically powered humidifying devices, which actively vaporize water or otherwise cause it to be evaporated into the air, are perhaps the most widely used. Although such humidifying devices are capable of adequately introducing water vapor into the air in many environments, there are several disadvantages and limitations associated with them.

First, electrically powered humidifying devices are typically relatively complex, with moving parts that induce the flow of air or that actively vaporize water. The cost of manufacturing such humidifying devices frequently precludes them from being used in situations where they would otherwise be beneficial. Likewise, the cost of supplying electrical energy further makes their use impractical in many settings.

It has also been found that conventional humidifying devices are generally bulky and not capable of being easily transported to new locations. For example,

humidifying devices used in refrigeration systems and in many human environments are generally permanently or temporarily fixed in place and cannot be easily moved. Furthermore, conventional humidifying devices are often associated with periodic maintenance that increases the cost of ownership and operation, thereby making such devices less likely to be used in many situations.

In view of the foregoing features of conventional humidifying devices, there is a need in the art for humidifying devices that are relatively inexpensive to manufacture and operate. It would also be desirable to provide humidifying devices that can be operated without electrical power or other external power supplies. It would be a further advantage if such humidifying devices were portable and easily handled by users. Furthermore, it would be advantageous to provide humidifying devices that are self-contained and that can be placed in desired environments without having to be permanently or temporarily secured them to a supporting structure.

SUMMARY OF THE INVENTION

The present invention relates to chemical compositions and associated apparatus and methods for evaporating water into an atmosphere. The chemical compositions are formed from combining water with at least one substance that dissolves in water such as sodium bicarbonate, a weak acid such as acetylsalicylic acid, or a mixture thereof. For example, it has been found that an aqueous composition formed from combining water, sodium bicarbonate, and acetylsalicylic acid is useful for raising and maintaining humidity in air to levels higher than would otherwise be expected.

The invention also relates to methods for using the aqueous compositions to prolong the useable or shelf life of a variety of perishable products, which may include foods, plant products, and the like. For instance, the aqueous compositions can be sprayed or otherwise applied directly to vegetables or other produce in grocery stores, restaurants, refrigerated trucks, or other locations, thereby maintaining the freshness of the vegetables or other produce for a period longer than is otherwise possible.

According to other implementations of the invention, the aqueous compositions can also be applied to evaporation devices that include a substantially rigid shell having a plurality of holes formed therein and encasing an absorbent

material. Application of the aqueous composition to the evaporation device can be performed in one of at least two general ways. First, the absorbent material in the evaporation device can have sodium bicarbonate and acetylsalicylic acid included therein during manufacturing or at another time. In this case, water is applied to the absorbent material, with the aqueous composition being formed at the evaporation device. Second, the aqueous composition can be formed outside of the evaporation device, after which it is applied to the absorbent material. Once the evaporation devices carry the aqueous composition of the invention, they can then be placed in any desired space in which humidity is to be introduced or maintained.

The evaporation devices of the invention provide significant advantages over conventional humidifying devices. The evaporation devices are self-contained units that do not require electrical power or other external energy sources. Accordingly, the evaporation devices can be used in many environments where conventional humidifying devices have been impractical or impossible. The cost of manufacturing and operating the evaporation devices disclosed herein are less than those associated with conventional humidifying systems, due to the simple design of the evaporation devices, their lack of moving parts, and their ability to operate without electricity. Another advantage of the evaporation devices of the invention is their portability and reusability in different locations.

It has been found that the aqueous compositions of the invention can be used in many applications. For example, the devices of the invention may be used to introduce humidity to produce bins and produce trucks and refrigerators, thereby extending the useable or shelf life of produce beyond what has been previously possible. The invention can also be used to prevent exposed, refrigerated meats, fish, seafood, cheeses, and other similar foods from prematurely discoloring or spoiling. The shelf life of cookies, breads, cakes, brown sugar, tortillas, and other dry or non-refrigerated foods can be extended according to the invention.

The aqueous compositions and evaporation devices also have use in human environments. For example, they can be placed near a sleeping person to prevent respiratory passages from drying out. Such techniques are particularly advantageous to treat persons suffering from asthma or other respiratory illnesses. One or more evaporation devices situated in an oxygen flow delivered to a supplemental oxygen-

dependent person can raise humidity levels of the oxygen and prevent the pronounced dryness of the respiratory system that is otherwise frequently experienced by such persons. In any of the foregoing examples, the evaporation devices provide the advantages of low cost, portability, non-electricity consumption, and reusability.

Additional advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by the practice of the invention. The advantages of the invention may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. These and other features of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the manner in which the above-recited and other advantages of the invention are obtained, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1A is a breakaway perspective view illustrating an evaporation device according to the invention.

Figure 1B is a breakaway perspective view illustrating an evaporation device similar to that of Figure 1A, but with a different shape.

Figure 2 is a flow chart illustrating the steps of a method according to the invention for assembling and later using an evaporation device to deliver humidity to the atmosphere.

Figure 3 is a perspective view of a pallet and a plurality of associated evaporation devices.

Figure 4 is a perspective view of a crate and an associated evaporation device.

Figure 5 is a breakaway perspective view depicting a produce crate equipped with the evaporation device of Figure 1A.

Figure 6 is a perspective view illustrating a refrigerated display case containing meats and cheeses and being equipped with the evaporation device of Figure 1A.

Figure 7 is a breakaway perspective view showing a cookie jar containing cookies and the evaporation device of Figure 1A.

Figure 8 is a perspective view illustrating the evaporation device of Figure 1A being used in a human environment.

Figure 9 is a breakaway perspective view illustrating a portion of a system equipped with a plurality of the evaporation devices of Figure 1A, wherein the system delivers oxygen or air to a patient.

Figure 10 is a breakaway perspective view depicting an evaporation device of the invention including a wafer substrate on which medicaments are carried.

Figure 11 is a flow chart illustrating the steps of a method according to the invention for assembling an later using an evaporation device to deliver medicaments to a patient.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to chemical compositions and associated apparatus and methods for evaporating water into an atmosphere. The chemical compositions are formed from combining water with at least one substance that dissolves in water such as sodium bicarbonate, a weak acid such as acetylsalicylic acid, or a mixture thereof. For example, it has been found that an aqueous composition formed from combining water, sodium bicarbonate, and acetylsalicylic acid is useful for raising and maintaining humidity in air to levels higher than would otherwise be expected.

The invention also relates to methods for using the aqueous compositions to prolong the useable or shelf life of a variety of perishable products, such as foods, plant products, and the like. For instance, the aqueous compositions can be sprayed or otherwise applied directly to vegetables or other produce in grocery stores, restaurants, refrigerated trucks, or other locations, thereby maintaining the freshness of the vegetables or other produce for a period longer than is otherwise possible.

The aqueous compositions of the invention can be used in combination with evaporation devices to conveniently evaporate water into the atmosphere. The

evaporation devices of the invention can include a substantially rigid shell encasing an absorbent material. Holes are formed through the shell to permit the flow of air between the exterior and interior of the shell. When the aqueous compositions of the invention are applied to the absorbent material, the evaporation device can be placed in any of a number of selected environments in order to increase or maintain the humidity level of the environment.

The evaporation devices can be self-contained, portable and capable of being placed in and removed from desired locations. Preferred embodiments of the evaporation devices of the invention are passive, in that they do not require an electrical power supply or other external power sources. Instead, the evaporation devices are placed in substantially any environment to which humidity is to be introduced and can operate without electrical energy.

The aqueous compositions of the invention have been found to have a variety of uses. The invention extends to methods for introducing humidity into selected environments according to the techniques disclosed herein. For example, the aqueous compositions can be used to extend the shelf life of vegetables and other produce in commercial and consumer settings. In addition, the evaporation devices can be used to preserve meats, fish, seafood, cheeses, other dairy products, and other foods in refrigerated environments. The aqueous compositions have also been found to extend the shelf life and preserve the taste and other properties of dry food, such as breads, cookies, brown sugar, tortillas, and the like, in refrigerated and non-refrigerated environments. Furthermore, the appearance and taste of heated food, such as roasted poultry, hot dogs, and the like, can be maintained using the aqueous compositions of the invention over periods of time that are longer than those otherwise possible in the absence of the invention.

In addition to the food preservation capabilities of the aqueous compositions disclosed herein, it has been found that they can be used to condition human environments and to deliver humidity to patients. For example, an evaporation device placed near a sleeping person can introduce humidity into the person's environment and can improve the person's ability to breathe, particularly for those suffering from asthma or other respiratory ailments. According to another example, one or more of the evaporation devices can be placed in an oxygen flow that is delivered to a

supplemental oxygen-dependent patient to humidify the oxygen flow and to reduce or eliminate the respiratory dryness that is often experienced by such patients.

I. Aqueous Compositions

In one embodiment, an aqueous composition that is formed from combining water, aspirin (acetylsalicylic acid), and sodium bicarbonate (baking soda) facilitates and prolongs the evaporation of moisture into the environment. While the amount and proportion of acetylsalicylic acid and sodium bicarbonate is certainly not critical, it has been found that the invention can be practiced by combining the acetylsalicylic acid and sodium bicarbonate at relative amounts by weight ranging from about 50% acetylsalicylic acid and 50% sodium bicarbonate to about 10% acetylsalicylic acid and 90% sodium bicarbonate. Combining the two substances at relative amounts by weight of about 20% acetylsalicylic acid and about 80% sodium bicarbonate is a preferred technique in some embodiments. However, other relative proportions of acetylsalicylic acid and sodium bicarbonate are entirely adequate and are encompassed by the invention.

While the inventor does not wish to be limited to any particular theory of operation, it is presently believed that the following physical process may be responsible for some of the enhanced evaporation of water into the atmosphere. Sodium bicarbonate is an example of a species that dissociates when dissolved in water, thereby lowering the freezing point of the water. When the aqueous compositions of the invention are used at temperatures at or near the freezing point of pure water, the cryoscopic effects of sodium bicarbonate can maintain the aqueous composition in a liquid state, which enables evaporation of the water to continue. Regardless of the physical processes that are responsible for producing the observed benefits of the invention, it has been found that the aqueous compositions of the invention are useful in generating and maintaining humidity in the atmosphere.

In general, the invention extends to aqueous compositions formed by combining any suitable substance that is soluble in water (such as a non-electrolyte, but preferably an electrolyte, and most preferably sodium bicarbonate). In particular, a preferred composition of this invention is an aqueous solution obtained by mixing water, sodium bicarbonate, and acetylsalicylic acid. The number of ions that an electrolyte generates when dissolved in water is one factor to be considered when

selecting another electrolyte to replace sodium bicarbonate, particularly when the aqueous composition is to be used at temperatures near or below the freezing point of pure water. In general, a greater number of ions is related to greater cryoscopic effects and a lower freezing temperature. When the aqueous composition is to be used in close proximity to food, another factor should be whether the electrolyte or any other substance soluble in water is safe and approved for use with food. More specifically, the species dissolved in water are preferably compatible with their use next to or on the items to which the appropriate level of humidity is to be provided by evaporation. While sodium bicarbonate has proved to be a useful solute for use in forming the aqueous compositions of the invention, those of skill in the art, upon learning of this disclosure, will recognize that the invention extends to and can be practiced with other substances soluble in water.

In other embodiments of the invention, the aqueous compositions are formed by combining a solute, such as sodium bicarbonate, with water in the absence of acetylsalicylic acid. According to still other embodiments, the aqueous compositions are formed by combining water and acetylsalicylic acid in the absence of sodium bicarbonate.

In still another embodiment of the invention, the aqueous compositions are formed from mixing water, at least one substance that dissolves in water such as sodium bicarbonate, and at least one cellulose-based material, starch-based material, or protein-based material. The cellulose-based material can be selected from the group consisting of cellulose, methylhydroxyethylcellulose, hydroxymethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxypropylmethylcellulose, hydroxyethylpropylcellulose, mixtures of the foregoing, and derivatives of the foregoing. The starch-based material can be selected from the group consisting of starch, amylopectin, amylose, sea gel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkyl starches, dextrins, amine starches, phosphate starches, dialdehyde starches, mixtures of the foregoing and derivatives of the foregoing. The protein-based material can be selected from the group consisting of prolamine, collagen derivates, gelatin, glue, casein, mixtures of the foregoing, and derivatives of the foregoing.

II. Use of Aqueous Compositions

The aqueous compositions disclosed herein can be used to introduce and maintain humidity in the atmosphere in any desired application. In one embodiment, the aqueous composition is used in a space that contains food, resulting in an elevated humidity level being generated and maintained in the environment of the food. To perform such methods, a technician places the composition in close proximity to the food that is to be preserved. As used herein, the term "close proximity" is defined to include placing the aqueous composition directly on the food and to also include placing the aqueous composition on or in an evaporation device, with the evaporation device being located in the space that contains the food.

Examples of food whose useable or shelf lives can be prolonged using the compositions of the invention include vegetables, fruits, meats, fish, seafood, cheeses, other dairy products, breads, cookies, brown sugar, tortillas, cooked poultry, cooked hot dogs, and other similar foods. The foregoing list is presented by way of example and not by limitation. Moreover, it is noted that the foregoing foods include those that are generally refrigerated, stored at or near room temperature, and stored in a heated environment.

As used herein, the term "refrigerated" shall have its commonly understood meaning, and refers to low-temperature conditions in which produce, meats, dairy products, and the like, are conventionally stored in the food industry. A food that is stored without any particular refrigeration or heating requirements according to conventional practice in the food industry is one example of a food stored at or near room temperature. A "heated environment," as used herein, extends to an environment heated to a temperature greater than room temperature for purposes of inhibiting spoilage or bacterial growth in foods. For instance, roasted chicken or cooked hot dogs are conventionally stored in heated environments for periods of time in the range of minutes or hours.

Any reference to preservation of the shelf life of food also extends to preservation of other products that are typically refrigerated or perishable, such as cut flowers. In addition, the aqueous compositions and the various methods for their use can be practiced in greenhouses or other controlled environments to enhance the growing conditions for live plants.

A. **Direct Application**

In one embodiment, the aqueous composition is applied directly to food. For instance, the food may be located in a refrigerated unit in a truck or in a retailer's establishment, in a display case at a grocery store, in a restaurant, or in any number of other locations. Direct application of the aqueous composition may be conducted by spraying the composition from a hose and nozzle that is conventionally used to spray water on vegetables or other produce.

Such direct application of the aqueous composition can have a dual effect that can prolong the useable or shelf life of vegetables, fruits, cut flowers, meats, fish, seafood, cheeses, and other similar foods from prematurely discoloring or spoiling. First, the aqueous composition enhances and prolongs the evaporation of water into the atmosphere. Second, the aqueous composition is in direct contact with the food, thereby preserving the moisture content of the food.

B. **Evaporation Device**

In another embodiment, the aqueous composition is applied to or formed in or on an evaporation device, such as that illustrated in Figure 1A. Evaporation device 10 includes a substantially rigid outer shell 12 (shown in breakaway view) encasing an absorbent material 14. Shell 12 has one or more holes 16 formed therethrough, which permits the transport of gas between the interior and the exterior of the shell. Preferably, shell 12 has a plurality of holes 16 randomly or regularly spaced thereon. The size of holes 16 can be selected to substantially prevent portions of absorbent material 14 from protruding outside of shell 12 during use and to substantially prevent objects in the environment of evaporation device 10 from coming in contact with the absorbent material 14. The size and number of holes 16 on shell 12 can be selected to increase or decrease the air flow rate between the interior and exterior of shell 12, thereby allowing the rate of evaporation to be partially controlled.

Absorbent material 14 can be essentially any material capable of retaining an aqueous medium in a manner such that water can be evaporated into the atmosphere. Suitable examples of absorbent material 14 include natural sponges and synthetic sponges, such as those commonly used in household settings. When absorbent material 14 consists of natural or synthetic sponges, the absorbent material can be divided into cubes or other regular or irregular shapes, one example of which is

illustrated in Figure 1A. Dividing absorbent material 14 into multiple pieces as illustrated provides the advantage of permitting air to flow around and between the pieces, and also increases the exposed surface area of the absorbent material from which moisture can evaporate.

In a preferred embodiment, absorbent material 14 is not packed in shell 12 so tightly that the interstices between the individual pieces and between the absorbent material and shell 12 are eliminated. Preserving some air space inside shell 12 permits adequate air flow through device 10, thereby enhancing evaporation of moisture. Packing considerations are particularly important when absorbent material 14 is a material that swells or expands when exposed to moisture. For example, absorbent material 14 is often packed in shell 12 in a dry state, with a size that may be significantly smaller than the size of the absorbent material when it is later exposed to water.

Shell 12, depending on the environment in which evaporation device 10 is to be used, can be constructed of any of a large number of materials. In one embodiment, shell 12 is constructed of a substantially rigid thermoplastic or thermosetting plastic. The factors involved in selecting the material for shell 12 can include water resistance, durability, wear properties, and inertness with respect to the materials expected to be encountered in the environment of evaporation device 10. Other examples of materials for use in shell 12 include metals and, in some applications, wood.

The aqueous composition is applied to evaporation device 10 according to one of at least two techniques. First, the substances that will eventually dissolve in water, such as sodium bicarbonate and acetylsalicylic acid, can be deposited at or in the absorbent material 14 during or after the manufacturing process, and before the introduction of water into evaporation device 10. According to this technique, the act of forming the aqueous composition is conducted as water is applied to absorbent material 14 and mixes with one or more solutes such as sodium bicarbonate and acetylsalicylic acid. For example, device 10 can be immersed in a volume of water or water can be poured over device 10. In either case, water enters holes 16 and is absorbed by absorbent material 14. Some or all of the water can eventually evaporate from absorbent material 14, thereby reducing the evaporation rate from device 10.

However, device 10 can be easily recharged in this situation by reapplying the composition to the absorbent material. It has been found that the sodium bicarbonate and acetylsalicylic acid can remain at absorbent material 14 during repeated recharging and evaporation cycles. Thus, the act of recharging device 10 can often merely include reapplying water to the absorbent material 14, which contains the residual sodium bicarbonate and acetylsalicylic acid.

According to a second technique for applying the aqueous composition to evaporation device 10, the composition is formed outside of the evaporation device by combining water with the sodium bicarbonate (or other electrolyte) and acetylsalicylic acid. For instance, a volume of the composition can be generated by the same technician who applies the composition to the evaporation device or, alternately, the composition can be manufactured and distributed to the end user. In this case, the act of applying the aqueous composition to evaporation device 10 can include immersing the device in the aqueous composition or pouring it over the evaporation device.

Once evaporation device 10 has the aqueous composition applied thereto, it is ready to be used to supply humidity to the environment. Evaporation device 10 introduces humidity into an environment as the water is evaporated from the surfaces of absorbent material 14 into the air contained within shell 12. Holes 16 permit humidified air to flow out of shell 12, and also allow water vapor to diffuse into the external environment. As can be seen in Figure 1A, evaporation device 10 can be an entirely passive device, in the sense that no electrical or other power supply is required. Moreover, in many instances, evaporation device 10 can supply a suitable amount of humidity without the use of fans or other devices for generating an air flow over the evaporation device. Of course, in some situations, inducing an air flow over and through evaporation device 10 using any desired external system can enhance the evaporation and introduction of moisture into the environment.

One advantage of the evaporation devices of the invention is that they can be used in environments where electrically operated humidifying devices would be impractical, undesirable, or impossible to use. Another advantage of the evaporation devices of the invention is the low cost of manufacturing and use compared with humidifiers that require electrical energy.

Evaporation device 10 can have substantially any desired size or shape. While evaporation device 10 of Figure 1A is spherical, other shapes can be used. Indeed, in many situations, shapes other than a sphere may be desired. For instance, a cubical, pyramidal, or other prismatic shape can reduce the possibility of the evaporation device rolling out of position. In any case, the invention extends to evaporation devices constructed according to the principles disclosed herein, regardless of the shape.

Figure 1B illustrates an example of an evaporation device 110 having a shape different from that of evaporation device 10 of Figure 1A. In all other respects, evaporation device 110 can be similar or identical to evaporation device 10. For instance, evaporation device 110 has a shell 112 that substantially encloses an absorbent material 114. Shell 112 has one or more holes 116 formed therethrough that permit flow or air between the interior and exterior of the shell.

In many circumstances, it can be desirable to provide evaporation devices 10 and 110 having a size sufficiently small to allow them to be lifted by a user and to be easily immersed in a volume of water. However, it should be recognized that evaporation devices can be as large as desired. It is noted that the surface area of three-dimensional objects does not increase proportionally to increases in the diameter of the objects. Accordingly, the evaporation efficiency of the evaporation devices of the invention can often be enhanced by providing several small devices as opposed to a single, larger evaporation device.

Because of the self-contained and portable nature of evaporation devices 10 and 110, the evaporation device can be relatively easily sterilized between uses if desired. For example, evaporation devices 10 and 110 can be immersed in boiling water or can be exposed to other thermal or chemical sterilization means.

Figure 2 is a flow diagram illustrating one embodiment of the methods for using the aqueous composition and the evaporation device of Figure 1A to introduce and maintain humidity in the atmosphere. As shown in step 46, one or more substances, such as acetylsalicylic acid and sodium bicarbonate, are applied to the absorbent material of the evaporation device. In step 48, the absorbent material is encased in the shell. At this stage in the method, the evaporation device has been manufactured and is ready for use.

In step 50, water is applied to the absorbent material by immersing the evaporation device in a volume of water or by pouring water over the evaporation device. Some of the water is absorbed into and retained by the absorbent material. The evaporation device is then placed in the selected environment into which humidity is to be introduced in step 52. As shown by step 54, the evaporation device releases humidity into the environment as disclosed herein. Depending on the nature of the environment, the absorbent material may eventually dry out, at which point the evaporation device can be recharged. According to decision block 56, if the evaporation device is to be recharged, the method advances again to step 50.

C. Pallets

In another embodiment of the invention, the aqueous composition is applied to an evaporation device that is attached to or integrated into a pallet, rather than being a unitary structure such as the evaporation device illustrated in Figure 1A. An example of a pallet and an associated plurality of evaporation devices is shown in Figure 3. Pallet 120 can be used to transport or store boxes or crates of fruits, vegetables, other perishable foods and flowers and other perishable products. In many respects, pallet 120 can be similar to conventional pallets that are widely used in shipping, warehousing, and food industries. In the example of Figure 3, pallet 120 has a body 122 that provides a support surface 124 for the crates or boxes that are to be placed thereon. Body 122 represents one example of means for supporting a perishable product during transport or storage. Moreover, pallets 120 can have elongated channels or grooves 125 configured to receive the tines of a forklift. The basic structure of pallets 120 and the nature of the means for supporting the perishable product can differ from the configuration shown in Figure 3. Pallets 120 can be formed of a thermoplastic, thermosetting plastic or other synthetic material or can be alternatively formed from wood or any other suitable material.

One feature of pallets 120 that is not found in conventional pallets is that pallets 120 are configured to receive, be attached to, or have integrally formed thereon one or more evaporation devices 126 for evaporating water into the atmosphere. Evaporation devices 126 have a basic structure that is similar to that of evaporation devices 10 and 110 of Figures 1A and 1B, respectively. In particular, evaporation devices 126 have a shell 128 that substantially encloses an absorbent material. Shell

128 has one or more holes 132 formed therethrough to permit flow of air between the inside and outside of the shell.

In the embodiment illustrated in Figure 3, pallet 120 has a plurality of chambers 134 formed in body 122 that are configured to receive evaporation devices 126. Each chamber 134 has a moveable panel 136 that opens to allow evaporation device 126 to be inserted and removes and closes to secure the evaporation device in position. Panels 136 and other portions of pallet 120 have openings 138 formed at positions to enable air to flow between evaporation devices 126 and the environment.

Pallet 120 can be used to supply humidity to a space where perishable products are transported or stored. An aqueous composition disclosed herein is applied to the absorbent material 130 of evaporation devices 126. In this manner, the evaporation of water into the atmosphere is enhanced and prolonged, thereby extending the useable life of the perishable products supported by pallet 120.

The pallets of the invention and the structure whereby the evaporation devices are secured to the pallets can differ from the specific embodiment illustrated in Figure 3. The invention extends to any pallet that is configured or adapted to be used with the aqueous compositions and evaporation devices disclosed herein.

The pallets of the invention can be used in any desired environment. For example, in view of the preservative effects of the evaporation devices and aqueous compositions of the invention, the pallets can be used for transporting by ship or truck perishable products that might otherwise require faster, more expensive transportation.

D. Crates

Cut flowers are conventionally transported from the grower to the retailer after being packed in ice and placed in a substantially airtight crate formed from a foam structural material. This technique often adequately prevents the flowers from wilting, but frequently results in some flowers being destroyed or damaged by frostburn resulting from direct contact with the ice.

Figure 4 illustrates a crate that is adapted to store cut flowers during transport. Crate 140 has a plurality of structural members 142 formed from wire, plastic, wood or any other suitable material. Structural members 142 define an interior of crate 140 in which the cut flowers are placed. Crate 140 also includes a removable or integrally

formed evaporation device 144 that can carry the aqueous compositions of the invention and has features similar to the other evaporation devices disclosed herein.

Using crate 140 to store cut flowers during transport can prolong the useful life of the flowers. Evaporation device 140 is charged with the aqueous composition of the invention, and the flowers are placed in crate 140 prior to transport. According to this technique, ice can be eliminated in flower shipping, thereby eliminating the losses due to frostburn that have been frequently experienced in the industry.

III. Examples

A number of examples of the use of the aqueous compositions of the invention follow in order to illustrate the wide range of applications of the aqueous compositions and the benefits that may be derived from their use. The following examples illustrate uses of evaporation device in combination with the aqueous compositions of the invention, unless indicated otherwise. However, many qualitatively similar benefits, although less dramatic, have been observed in some environments using only water, water in combination with only acetylsalicylic acid, or water in combination with only sodium bicarbonate or another suitable electrolyte. The invention extends to such uses in addition to the others disclosed herein.

Example 1

Figure 5 illustrates an evaporation device of the invention being used to preserve the shelf life of produce. Evaporation device 10 is constructed and activated by the application of water as described above in reference to Figure 1A. Figure 5 illustrates a produce crate 18 (shown in break away perspective). Crate 18, in this example, contains heads of lettuce 20 that have been packed after being harvested and in preparation to be shipped to retailers, where the lettuce will be sold to consumers. It is widely understood in the produce industry that lettuce, other vegetables, and other produce have a limited shelf life, and must be sold to consumers within a specified amount of time. The limited shelf life contributes to significant shipping and handling expenses, since the produce must be delivered to the consumer is a short amount of time.

It is standard practice in the produce industry to sell lettuce to consumers within four or five days after the lettuce has been harvested from the field. Accordingly, lettuce ordinarily is shipped to the retailer within about 72 hours after

harvest. This rough 72-hour standard limits the distance that lettuce can be shipped by truck from particular growing areas. Moreover, for geographic regions relatively distant from lettuce growing areas, lettuce must be in transport nearly night and day in order to arrive within the 72 hours. Such intense shipping practices combined with occasional spoilage contributes to the expense of produce at the consumer level.

It has been found that including an evaporation device 10 in crate 18 before lettuce 20 or other produce is shipped can inhibit the spoilage or other degradation of the produce. When evaporation device 10 is placed in the environment of lettuce 20 or other produce, particularly in closed spaces as shown in Figure 5, the humidity introduced into the environment has a preservative effect on the produce. For instance, it has been discovered that using the aqueous compositions and evaporation devices of the invention can lengthen the traditional shelf life of produce by an additional one to three days or more.

It has also been found that placing evaporation device 10 in a refrigerated truck that transports the lettuce has a similar preservative effect on the produce. Moreover, experimentation has shown that evaporation device 10 can also extend the shelf life of produce that is stored in a refrigerated unit at a grocery store or displayed in a refrigerated display case.

Delivering humidity to refrigerated produce environments as shown in Figure 5 has significant advantages over merely placing electrically operated humidifying systems in refrigerated trucks or other refrigerators. For example, evaporation device 10 can be conveniently placed within individual crates as shown in Figure 5, which has not been possible using electrical systems. Moreover, the evaporation devices of the invention are significantly less expensive to manufacture and operate the electrically powered humidifying systems. In addition, evaporation device 10 can remain in crate 18 after the crate is transported from the truck space to the retailer's cold storage unit. Beyond such logistical advantages, it has been found that the use of the evaporation devices of the invention can extend the usable life of lettuce and other produce well beyond what has been achieved by conventional electrically powered humidifying systems.

While Figure 5 illustrates evaporation device 10 being used with lettuce, the invention can be practiced with substantially any other type of vegetable and with

many fruits to extend the usable life thereof. The preservative effects of the invention can be observed in a variety of situations, including those wherein the evaporation devices carrying the aqueous composition is placed in a refrigerated truck, a walk-in refrigeration unit at a grocery store, or in other refrigerated environments.

Example 2

In one experiment, it was found that the evaporation devices disclosed herein extend the usable life of lettuce one to three days beyond that which is otherwise observed. In particular, the onset of yellowing of lettuce leaves and other degradation of the lettuce was delayed about one to three days when an evaporation device carrying the aqueous composition was placed in a refrigerated unit where the lettuce was stored. Such food preservation capabilities can have great advantages in the produce industry. Shipping expenses can be reduced because the urgency of delivering the produce to the retailer is diminished. In addition, the retailer can now receive produce shipments on a weekly basis instead of receiving shipments every day or several times a week as has previously been common.

Example 3

In one experiment, the aqueous composition was applied to an evaporation device that was placed directly in a fresh vegetable salad that included a quantity of cut lettuce and other vegetables. It was found that the vegetable salad remained fresh, green, and had an attractive appearance for a longer period of time than has been observed in the absence of the evaporation device. Thus, restaurant operators can advantageously use the present invention to prolong the useable life of vegetable salads and obtain costs savings both in the frequency of preparing such salads and in the amount of food that spoils and must be discarded.

Example 4

It has been found that the evaporation devices carrying the aqueous compositions can be used in an open-air refrigerated produce display case at a grocery store to prolong the shelf life of a variety of vegetables and fruits. In one experiment, a number of evaporation devices carrying an aqueous composition of the invention were placed near the rear of an open-air refrigerated produce display case at regular intervals of about two feet. The evaporation devices had a dimension of about 2 inches x 2 inches x 2 inches.

In this experiment, the leafy vegetables maintained a fresh and attractive appearance longer than was observed in the absence of the invention. Moreover, the useable life of the vegetables and fruits was prolonged by an amount similar to that described above in Examples 1-3.

Example 5

It has been found that placing evaporation devices in retailers' refrigerated cut flower cases has a preservative effect on the flowers. Leaves and petals maintain an attractive and fresh appearance for a period of time longer than that observed in the absence of the invention. Particularly delicate flowers, such as baby's breath, have experienced some of the most significant benefits.

Example 6

Evaporation devices carrying the aqueous compositions of the invention can provide significant benefits when placed in greenhouses where plants are grown. For example, the evaporation devices can reduce drying of plants in controlled environments, thereby reducing the frequency of waterings. Fewer waterings can lead to reduced fungus and mildew growth on the plants, contributing to the overall vitality of the plants. Substantially any plant grown in greenhouses or controlled environments, including vegetables, flowers, rice, etc., can benefit from the maintenance of adequate humidity associated with the use of the evaporation devices and aqueous compositions of the invention.

Example 7

Figure 6 illustrates another use of the evaporation devices of the invention, whereby meats, fish, seafood, cheeses, and other refrigerated foods are preserved. Restaurant operators and grocery retailers often display meats 22, cheeses 24, and other similar foods in refrigerated display units 26. In order to display these foods to consumers, they are often left uncovered. However, the exposure of meats 22 and cheeses 24 to the ambient air induces a degradation process that discolors the food and can also have a deleterious effect on the foods' taste.

It has been found that including one or more evaporation devices 10 in refrigerated display unit 26 inhibits the discoloration of meats 22 and cheeses 24 and otherwise preserves the shelf life thereof. The portable, reusable, and non-energy consumptive properties of evaporation devices 10 provide many of the same

advantages in the context of Figure 4 as those described in the other examples disclosed herein. Among the many advantages of using evaporation devices 10 in refrigerated display units 26, the food contained therein can be left uncovered for an extended period of time. For example, retailers and restaurant operators have the option of leaving meats 22 and cheeses 24 uncovered overnight, while preserving the appearance of the food and otherwise extending its shelf life. This embodiment of the methods of the invention can also be practiced in other refrigerated units at the retail level and in refrigerators of consumers.

Grocery stores and retailers often display shaved meats, cheese, potato salads, egg salads, macaroni salads, and the like, in deli display cases. In the absence of the invention, many retailers find it desirable to stir or turn salads roughly every hour due to the drying and discoloration of the surface of the salads as they are exposed to air. However, using the evaporation devices carrying the aqueous compositions of the invention, salads only need to be turned once every several hours in order to maintain a fresh and attractive appearance.

Example 8

In one experiment, evaporation devices carrying an aqueous composition and having a dimension of approximately 2 inches x 2 inches x 2 inches were placed in a service meat display case similar to the display unit 26 of Figure 6 in order to observe the preservative effects on meat and seafood. The evaporation devices were positioned roughly every two feet along the length of the case. In order to enhance evaporation, the devices were positioned near an airflow unit that circulates refrigerated air through the case.

As a result of the evaporation devices, the exposed meats maintained a fresh appearance for a period of time longer than that observed in the absence of the invention. This effect can lead to less frequent loss of meat due to discoloration and other spoilage. In addition, vegetable garnishes, such as kale, that were displayed along with the meats experienced significantly diminished drying and discoloration. For instance, the operator of the service meat display case found it entirely acceptable to replace the garnishes on the order of once every five days rather than on a daily basis, which had been necessary prior to the experiment.

Example 9

As illustrated in Figure 7, the evaporation devices can be used to preserve food in non-refrigerated environments. According to one example, cookie jar 28 has cookies 30 stored therein. It has been widely observed in the past that cookies rapidly dry out when stored in cookie jars at room temperature. It has been found that introducing an evaporation device 10 into cookie jar 28 can significantly increase the shelf life of cookies 30. Evaporation device 10 can similarly be used to preserve breads, tortillas, cakes, brown sugar, and other dry foods.

Example 10

In one experiment, an evaporation device 10 of Figure 1A carrying the aqueous composition of the invention was placed in a container of brown sugar that had become hardened, dry, and unusable. Within hours, the brown sugar had become noticeably softer and appeared to be in a condition nearly as good as new brown sugar.

Example 11

In another experiment, evaporation devices carrying an aqueous composition of the invention were positioned in a heated display case used to store cooked food, including fried chicken, mashed potatoes, and macaroni. Prior to the use of the evaporation devices of the invention, fried chicken was typically discarded at roughly 1 to 1 ½ hours after cooking due to loss of moisture. In the experiment, the evaporation devices were positioned in the heated display case, with some being located directly in a pile of fried chicken, and others being in locations other than in direct contact with the food products.

As a result of the experiment, it was found that the mashed potatoes and macaroni maintained an acceptably good appearance and freshness for an extended period of time. Furthermore, the fried chicken retained its moisture and appearance to the extent that it remained useable after two to three hours or more.

Example 12

It has also been found that the invention can be used to advantageously introduce and maintain a relatively high humidity level into human environments. The evaporation devices can be used to introduce humidity into air breathed by a person. While the evaporation device is not limited to the setting depicted in Figure

8, it has been discovered that a particularly useful method of the invention involves placing an evaporation device 10 near a sleeping person 32. When evaporation device 10 is charged with water, it can introduce enough water vapor into the atmosphere to substantially prevent breathing passages from drying out in otherwise dry air. While any person can benefit from the use of evaporation device 10 as shown in Figure 8, this embodiment can be particularly useful to persons with asthma or other respiratory ailments.

The use of the evaporation devices of the invention to deliver humidity to the atmosphere of a human environment has significant advantages similar to those discussed herein in reference to other examples. For instance, evaporation device 10, requiring no electrical energy, can be inexpensive to manufacture and operate. Furthermore, evaporation device 10 can be placed very near to the face of person 32 when compared to electrically powered humidifying appliances for safety and other practical concerns, that have been conventionally used for similar purposes. Indeed, evaporation device 10 can be placed on the bed of person 32, whereas electrically operated humidifying appliances must be placed at a distant location in the room. The invention can also be practiced in any of a large number of other human environments.

Example 13

Figure 9 illustrates a further embodiment of the methods of the invention, whereby the evaporation device introduces an evaporated material into an air flow delivered to a patient. Figure 9 illustrates a segment of a system that delivers oxygen or air to a patient. A chamber 34 of the system has an inlet tube 36 that delivers oxygen or air from an atmosphere source. The atmosphere source may be an oxygen tank or a fan or another device that induces an air flow through inlet tube 36. Likewise, chamber 34 has an outlet tube 38 for delivering oxygen or air to the patient. One or more evaporation devices 10 are placed in chamber 34 for purposes further described below.

In one embodiment, the system of Figure 9 can be used to introduce water vapor into an oxygen flow delivered to a patient dependent on a supplemental source of oxygen. In the past, it has been found that patients requiring a supplemental flow of oxygen frequently experience pronounced drying and irritation of the respiratory

system. The water vapor that is inexpensively introduced to the oxygen flow can significantly alleviate this problem. As oxygen flows from inlet tube 36 into chamber 34 and around and through evaporation devices 10, water vapor is introduced into the oxygen. Because Figure 9 illustrates evaporation devices 10 being used in an environment having an induced flow of atmosphere, water vapor can be introduced at an even greater rate in this example than in many of the other examples that do not have an induced airflow.

Example 14

The invention extends to still other methods for using the evaporation devices. For example, an evaporation device having a shell and enclosed absorbent material can be used to introduce water vapor to plant environments. Such plant environments can include greenhouses, terrariums, and the like. Placing the evaporation device in plant environments can reduce the frequency by which plants must be watered, and can maintain a desirably high level of humidity. In another embodiment, an evaporation device can be configured to receive or be placed near to one or more seeds to facilitate the germination thereof. In this case, the evaporation device may be given a shape and size that conveniently allows the seeds to be secured in or near the evaporation device.

Example 15

The example of Figure 9 also illustrates an environment in which the evaporation devices can be used to provide evaporation of substances other than water. In particular, the absorbent material of evaporation devices 10 can receive a medicament capable of being evaporated into air or oxygen. As the air or oxygen passes from inlet tube 36, through chamber 34 and around and through evaporation devices 10, a controlled amount of a medicament can be introduced into the gas flow. The medicament-laden air can then be delivered to the respiratory system of a patient via outlet tube 38.

Any of a wide variety of medications that can be evaporated, inhaled, and absorbed by a patient through the lungs may be used in evaporation devices 10. While the evaporation devices used to deliver medication to a patient can be that illustrated in Figures 1A and 1B, evaporation device 40 of Figure 10 can alternatively be used. Like evaporation device 10 of Figure 1A, evaporation device 40 includes a

shell 12 having holes 16 formed therethrough. Shell 12 in this embodiment includes a wafer 42, which can be a gauze strip, a substrate, or any other structure for absorbing or supporting the medicament. In this embodiment, shell 12 is capable of being opened at a seam 44, which is one example of the means for opening shell 12.

For example, seam 44 can be formed where the two hemispheres of shell 12 are threadedly and removably engaged one with another, thereby allowing water 42 to be removed and replaced between uses. While evaporation device 40 contains a wafer 42 instead of the absorbent material 14 of Figure 1A, the operation of the evaporation device is very similar to the other evaporation devices disclosed herein. In particular, air or another gas passes through holes 16 into the interior of shell 12, where it receives the water vapor or medicament evaporated from wafer 42.

Figure 11 illustrates a method of manufacturing and then using the evaporation device to administer a medicament to a patient. The method of Figure 11 may be practiced, for example, in the environment illustrated in Figure 9. In step 58, a medicament is applied to the absorbent material or to another structure in the shell of the evaporation device according to the techniques disclosed herein. In step 60, the evaporation device is placed in an evaporation chamber, such as chamber 34 of Figure 9. In step 62, a flow of oxygen or air is induced through the evaporation chamber. The medicament then evaporates into the atmosphere in step 64. According to step 66, the medicament-laden atmosphere is delivered to the patient. Next, in step 68, the medicament is inhaled by the patient. As shown in decision block 70, the treatment can be repeated the same or for a different patient, in which case the method advances again to step 58.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed and desired to be secured by United States Letters Patent is:

1. A method for evaporating water into the atmosphere so as to prolong the useable life of a perishable product, comprising the steps of:

obtaining an aqueous composition formed from combining at least water and a species that dissolves in water; and

placing the aqueous composition in close proximity to the perishable product such that water from the aqueous composition evaporates into the atmosphere in close proximity to the perishable product.

2. A method as defined in claim 1, wherein the step of placing the aqueous composition in close proximity comprises the step of applying the aqueous composition directly to the perishable product.

3. A method as defined in claim 2, wherein the perishable product comprises food and the step of applying the aqueous composition directly comprises the step of spraying the aqueous composition onto the food.

4. A method as defined in claim 1, wherein the step of placing the aqueous composition in close proximity comprises the step of applying the aqueous composition to an evaporation device including:

a shell having one or more holes formed therethrough; and

an absorbent material substantially enclosed by the shell, the absorbent material receiving the aqueous composition.

5. A method as defined in claim 1, wherein the species that substantially dissociates is sodium bicarbonate.

6. A method as defined in claim 4, wherein the aqueous composition is formed from combining at least water, sodium bicarbonate, and acetylsalicylic acid.

7. A method as defined in claim 6, wherein the step of obtaining the aqueous composition comprises the step of forming the aqueous composition upon the application of water to the absorbent material of the evaporation device, the water combining with sodium bicarbonate and acetylsalicylic acid deposited at the absorbent material.

8. A method as defined in claim 6, wherein the step of obtaining the aqueous composition comprises the step of forming the aqueous composition outside the shell of the evaporation device.

9. A method as defined in claim 1, wherein the aqueous composition is formed from combining at least the water, the species that dissolves in water, and a cellulose-based material selected from the group consisting of cellulose, methylhydroxyethylcellulose, hydroxymethylcellulose, carboxymethylcellulose, methylcellulose, ethylcellulose, hydroxyethylcellulose, hydroxypropylmethylcellulose, hydroxyethylpropylcellulose, mixtures of the foregoing, and derivatives of the foregoing.

10. A method as defined in claim 1, wherein the aqueous composition is formed from combining at least the water, the species that dissolves in water, and a starch-based material selected from the group consisting of starch, amylopectin, amylose, sea gel, starch acetates, starch hydroxyethyl ethers, ionic starches, long-chain alkyl starches, dextrins, amine starches, phosphate starches, dialdehyde starches, mixtures of the foregoing and derivatives of the foregoing.

11. A method as defined in claim 1, wherein the aqueous composition is formed from combining at least the water, the species that dissolves in water, and a protein-based material selected from the group consisting of prolamine, collagen derivates, gelatin, glue, casein, mixtures of the foregoing, and derivatives of the foregoing.

12. A method for evaporating water into the atmosphere so as to prolong the useable life of a perishable product, comprising the steps of:

obtaining an evaporation device having:

a shell with a plurality of holes formed therethrough;

an absorbent material substantially enclosed by the shell; and

a composition deposited at the absorbent material, the composition being formed by mixing at least acetylsalicylic acid and another species such that the composition dissolved in water depresses the freezing point of water;

applying water to the absorbent material and the composition; and

placing the evaporation device in proximity to the perishable product.

13. A method as defined in claim 12, wherein the evaporation device is a unitary structure.

14. A method as defined in claim 12, wherein the evaporation device is integrated with a pallet.

15. A method as defined in claim 12, wherein the perishable product comprises food.

16. A method as defined in claim 15, wherein the step of placing the evaporation device in close proximity to the perishable product comprises the step of placing the evaporation device in a refrigerated space in which the food is stored.

17. A method as defined in claim 15, wherein the step of placing the evaporation device in close proximity to the perishable product comprises the step of placing the evaporation device in a space in which the food is stored, the atmosphere in the space being substantially at room temperature.

18. A method as defined in claim 15, wherein the step of placing the evaporation device in close proximity to the perishable product comprises the step of placing the evaporation device in a heated environment in which the food is stored.

19. A method as defined in claim 12, wherein the perishable product comprises cut flowers.

20. A method as defined in claim 12, wherein the perishable product comprises live plants, the step of placing the evaporation device in close proximity to the perishable product comprises the step of placing the evaporation device in a controlled environment in which the live plants grow.

21. A method as defined in claim 12, wherein said species comprises sodium bicarbonate.

22. An apparatus for evaporating a water into the atmosphere, comprising:

a shell having at least one hole formed therethrough; and

an absorbent material substantially enclosed by the shell, the absorbent material being adapted to absorb the water; and

a composition deposited at the absorbent material, the composition being formed from combining at least acetylsalicylic acid and another species such that the composition dissolved in water depresses the freezing point of water.

23. An apparatus as defined in claim 22, wherein said species comprises sodium bicarbonate.

24. An apparatus as defined in claim 22, wherein the composition is formed from combining at least water, the acetylsalicylic acid, and the species such that the composition dissolved in water depresses the freezing point of water.

25. An apparatus as defined in claim 22, further comprising a pallet attached to the shell.

26. An apparatus for evaporating water into the atmosphere, comprising:

a pallet including means for supporting a perishable product during at least one of transport and storage;

an evaporation device attached to the pallet, the evaporation device including:

an absorbent material capable of absorbing the water; and

a shell substantially enclosing the absorbent material, the shell having one or more holes formed therethrough.

27. An apparatus as defined in claim 26, wherein the means for supporting the perishable product comprises a body that has channels formed therein to receive the tines of a forklift.

28. An apparatus as defined in claim 26, wherein the plurality of body is formed from a plastic material.

29. An apparatus as defined in claim 26, wherein the evaporation device further comprises a composition deposited at the absorbent material, the composition being formed from combining at least acetylsalicylic acid and a species such that the composition dissolved in water depresses the freezing point of water.

30. An apparatus as defined in claim 26, wherein the evaporation device further comprises an aqueous composition applied to the absorbent material, the aqueous composition being formed from combining at least the water and a species that depresses the freezing point of water when combined with water.

31. An apparatus as defined in claim 30, wherein the species that depresses the freezing point of water when combined with water comprises sodium bicarbonate, the aqueous composition being formed from combining at least the water, the sodium bicarbonate, and acetylsalicylic acid.

32. An apparatus as defined in claim 26, wherein the evaporation device is integrally formed with the pallet.

33. An apparatus for evaporating water into the atmosphere, comprising:

a crate having an interior wherein a perishable product can be stored during at least one of transport and storage;

an evaporation device in the interior of the crate, the evaporation device including:

an absorbent material capable of absorbing the water; and

a shell substantially enclosing the absorbent material, the shell having one or more holes formed therethrough.

34. An apparatus as defined in claim 33, wherein the evaporation device further comprises a composition deposited at the absorbent material, the composition being formed from combining at least acetylsalicylic acid and a species such that the composition dissolved in water depresses the freezing point of water.

35. An apparatus as defined in claim 33, wherein the evaporation device further comprises an aqueous composition applied to the absorbent material, the aqueous composition being formed from combining at least the water and a species that depresses the freezing point of water when combined with water.

36. An apparatus as defined in claim 35, wherein the species that depresses the freezing point of water when combined with water comprises sodium bicarbonate, the aqueous composition being formed from combining at least the water, the sodium bicarbonate, and acetylsalicylic acid.

37. An apparatus as defined in claim 33, wherein the evaporation device is integrally formed with the crate.

38. A method of manufacturing an apparatus for evaporating liquid into the atmosphere, comprising the steps of:

depositing at an absorbent material a composition formed from combining acetylsalicylic acid and a species that depresses the freezing point of water when combined with water; and

substantially enclosing the absorbent material in a shell having at least one hole formed therethrough.

39. A method of manufacturing as defined in claim 38, wherein the step of depositing is conducted prior to the step of substantially enclosing.

40. A method of manufacturing as defined in claim 38, wherein the step of substantially enclosing is conducted prior to the step of depositing.

41. A method of manufacturing as defined in claim 38, wherein the species that depresses the freezing point of water comprises sodium bicarbonate, the step of depositing comprising the steps of:

forming an aqueous composition by combining at least water, the acetylsalicylic acid, and the sodium bicarbonate;

applying the aqueous composition to the absorbent material; and

permitting the water to substantially evaporate from the aqueous composition.

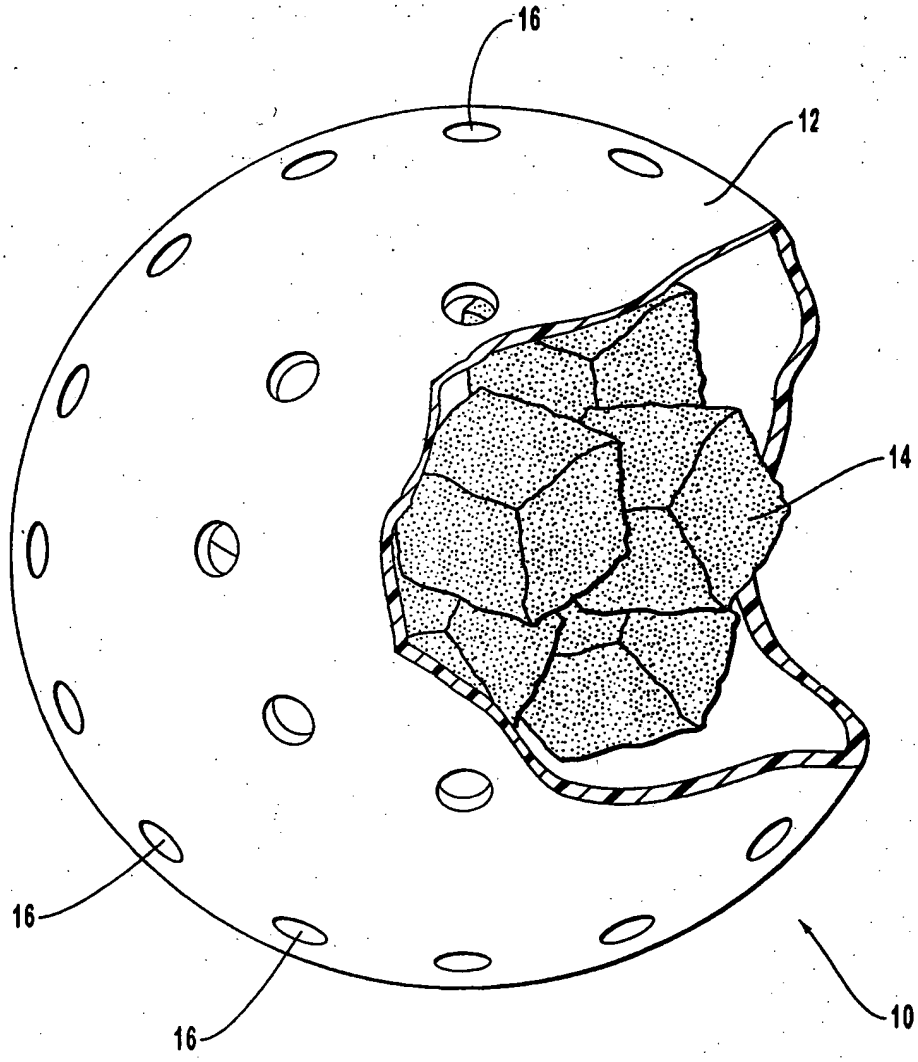

FIG. 1A

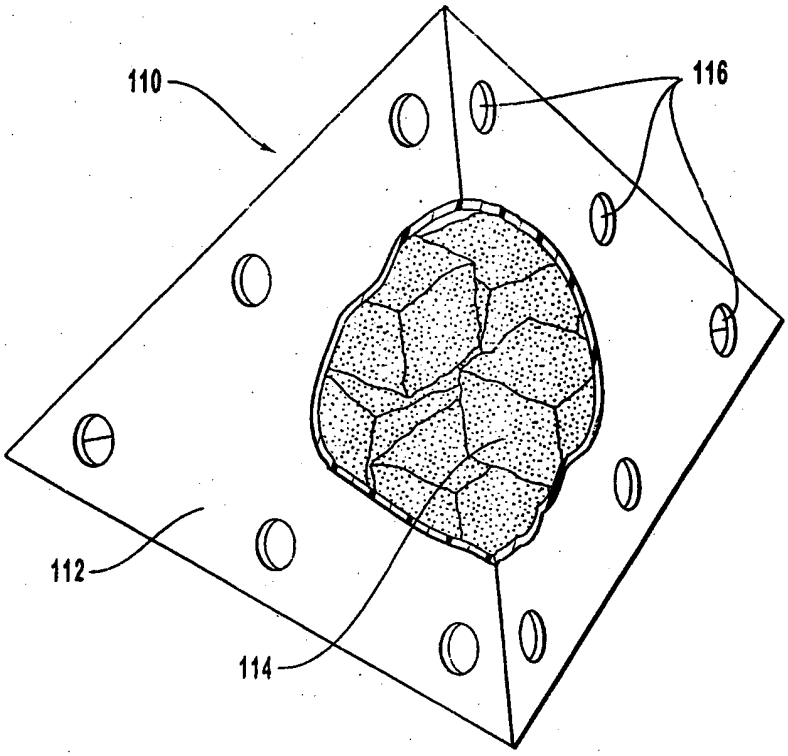

FIG. 1B

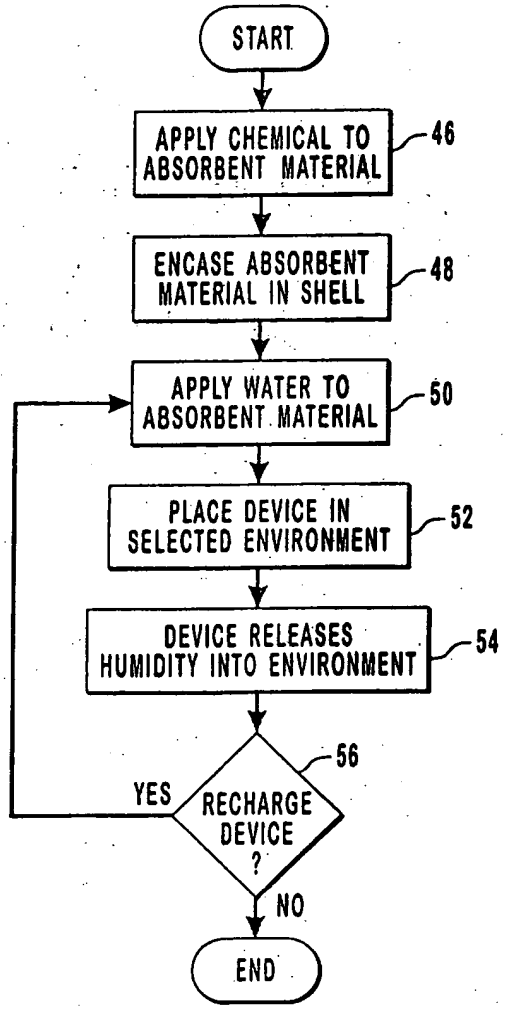
START
APPLY CHEMICAL TO ABSORBENT MATERIAL
46
ENCASE ABSORBENT MATERIAL IN SHELL
48
APPLY WATER TO ABSORBENT MATERIAL
50
PLACE DEVICE IN SELECTED ENVIRONMENT
52
DEVICE RELEASES HUMIDITY INTO ENVIRONMENT
54
56
YES
RECHARGE DEVICE ?
NO
END

FIG. 2

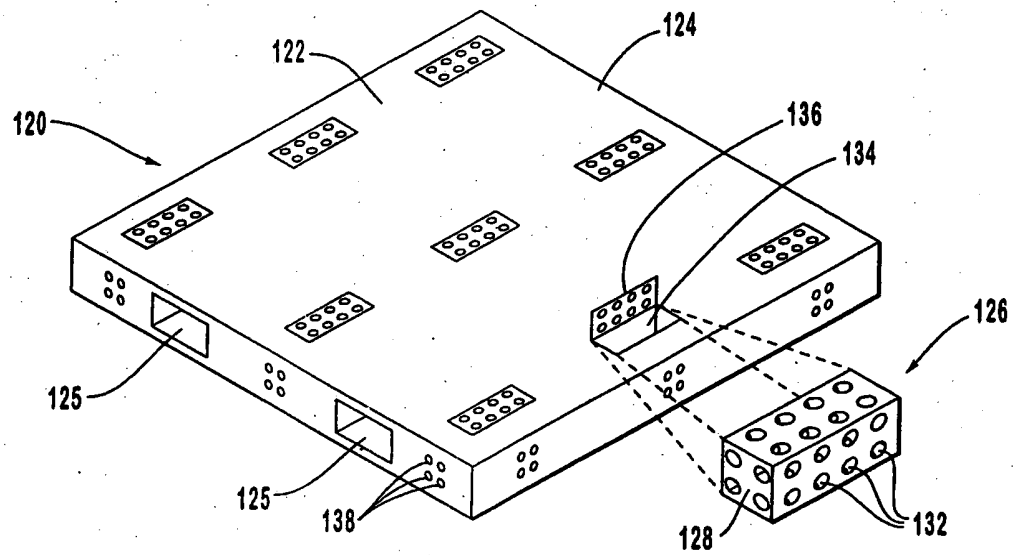

FIG. 3

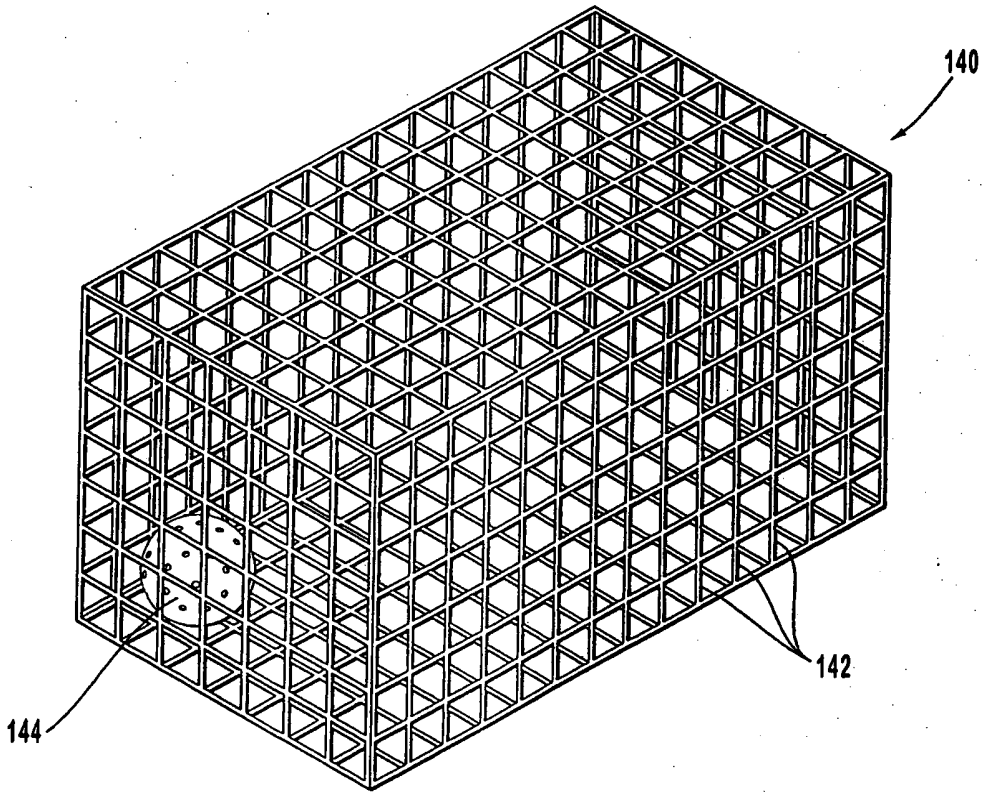

FIG. 4

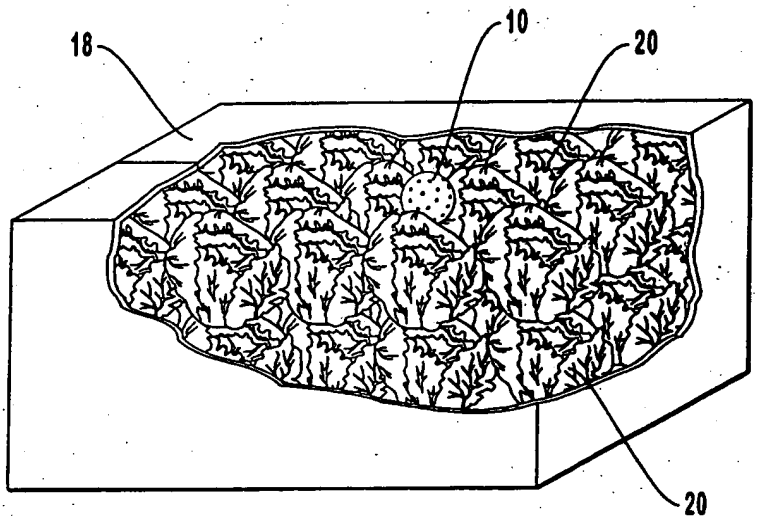

FIG. 5

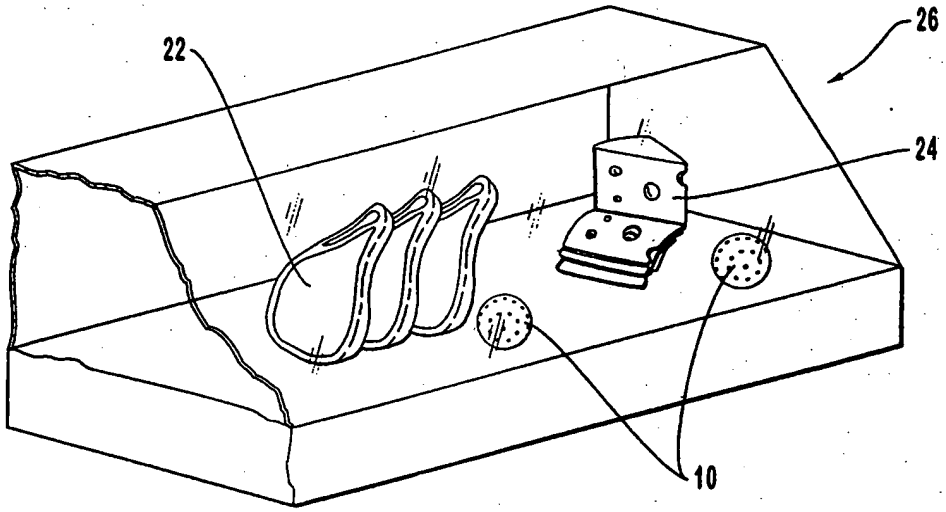

FIG. 6

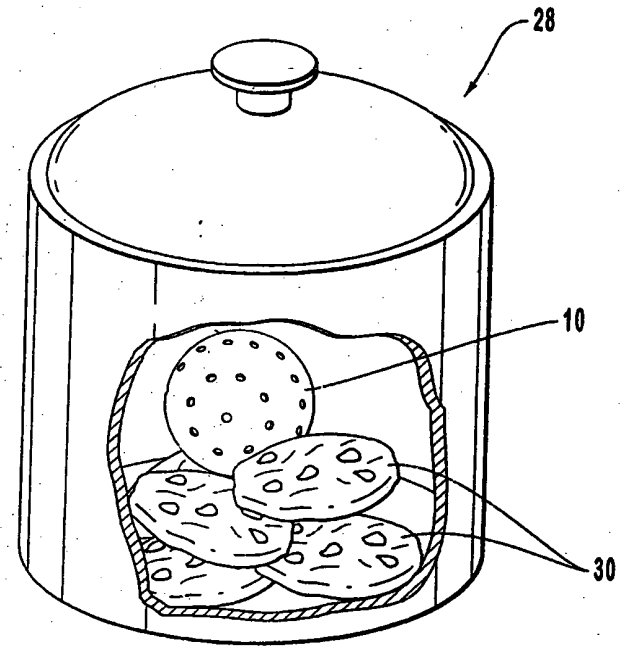

FIG. 7

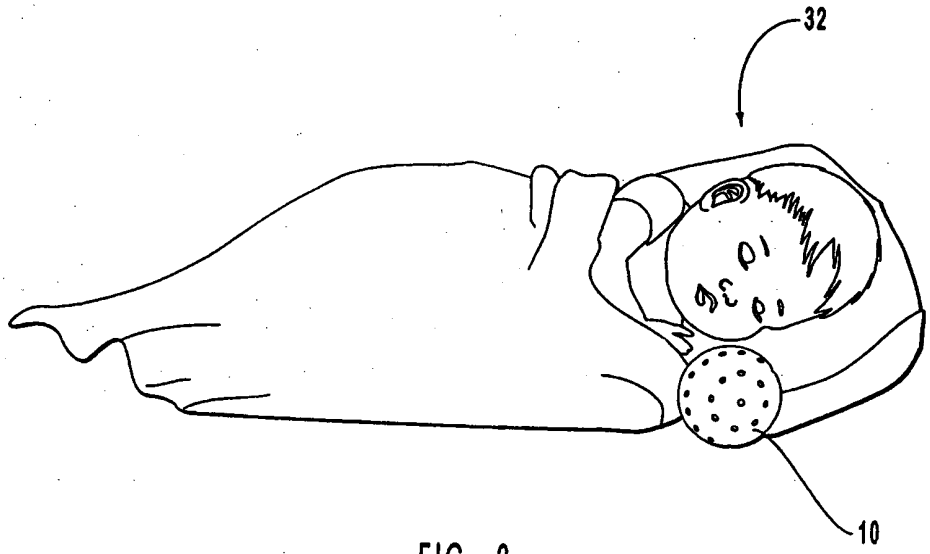

FIG. 8

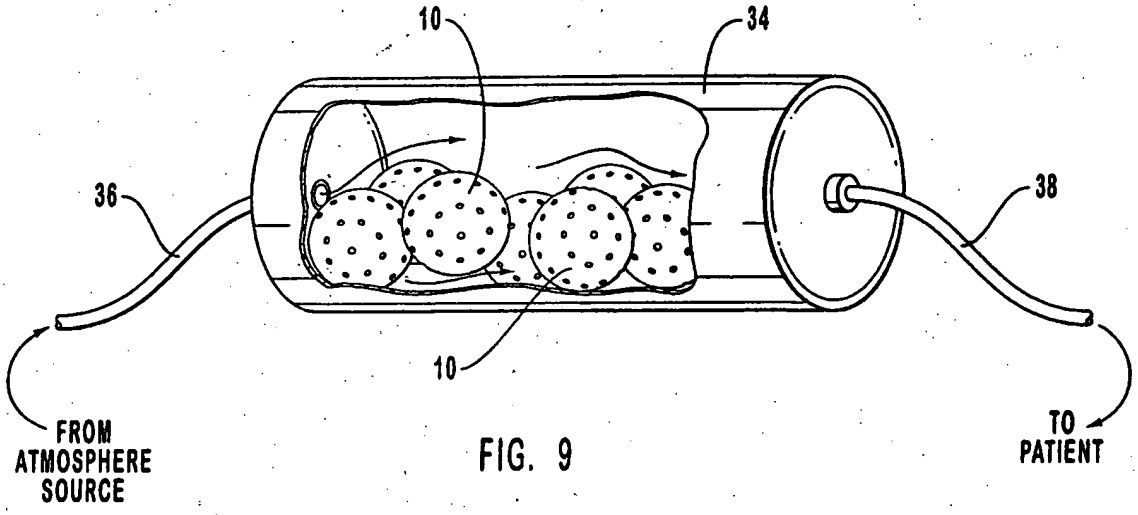
10
34
36
38
10
FROM ATMOSPHERE SOURCE
TO PATIENT

FIG. 9

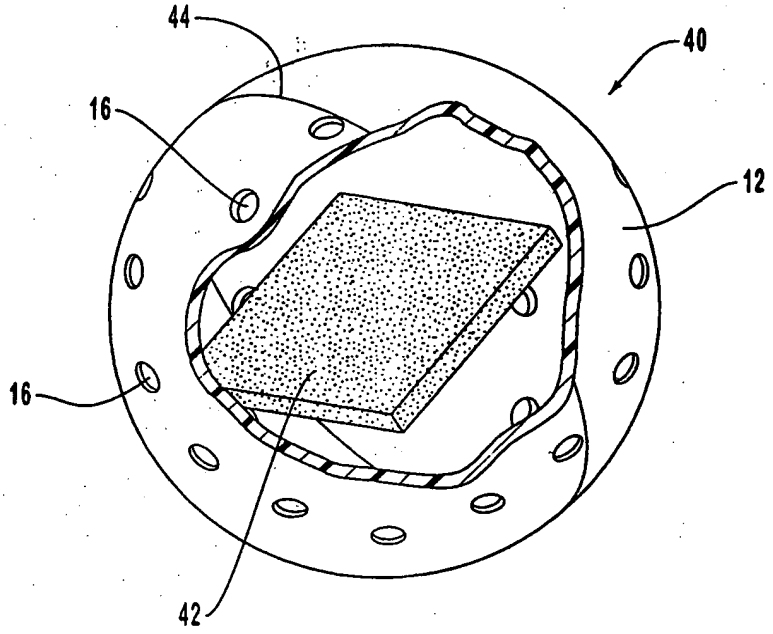
44
40
16
12
16
42

FIG. 10

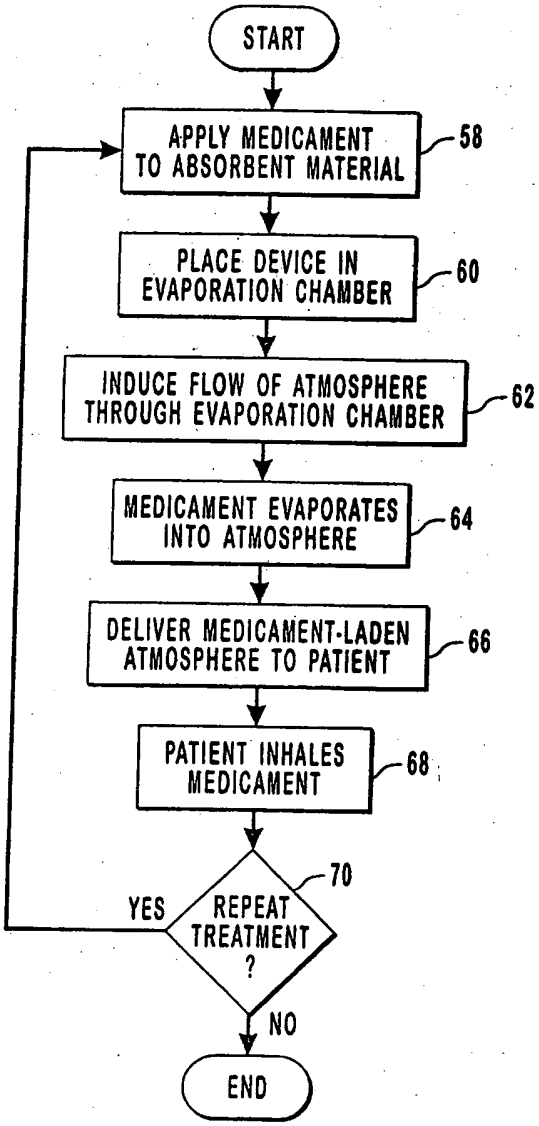
START
APPLY MEDICAMENT TO ABSORBENT MATERIAL
58
PLACE DEVICE IN EVAPORATION CHAMBER
60
INDUCE FLOW OF ATMOSPHERE THROUGH EVAPORATION CHAMBER
62
MEDICAMENT EVAPORATES INTO ATMOSPHERE
64
DELIVER MEDICAMENT-LADEN ATMOSPHERE TO PATIENT
66
PATIENT INHALES MEDICAMENT
68
REPEAT TREATMENT ?
70
YES
NO
END

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/23420

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :A61L 9/04
US CL :422/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 422/40, 4, 5, 120, 122, 123, 305, 306; 426/418, 419, 506

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST, search terms: sodium bicarbonate, acetylsalicylic acid, baking soda, aspirin

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3,924,807 A (MORGAN) 09 December 1975, whole document, especially col. 1.	1-41
Y	US 4,995,556 A (ARNOLD, III) 26 February 1991, see whole document, especially col. 1.	1-41
A	US 3,754,803 A (UNDERWOOD et al) 28 August 1973, see whole document.	1-41
A	US 4,192,773 A (YOSHIKAWA et al) 11 March 1980, see whole document.	1-41

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"B"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
13 DECEMBER 1999

Date of mailing of the international search report
19 JAN 2000

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Form PCT/ISA/210 (second sheet)(July 1992)★